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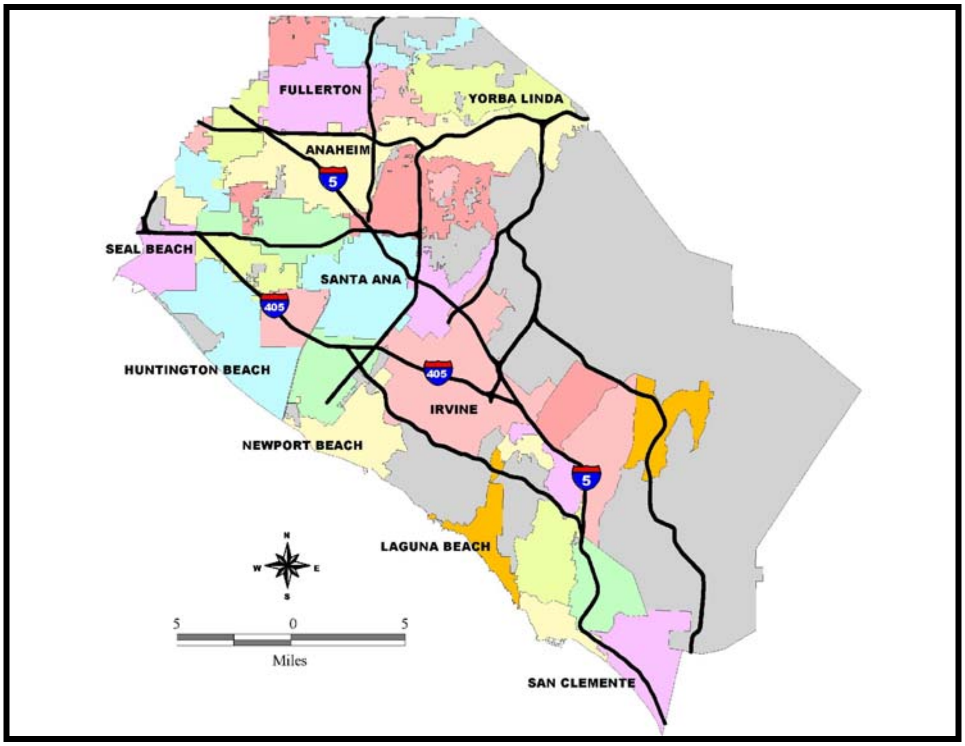
Transportation Case Studies in GIS

Case Study 6: GIS for Transit Planning at OCTA

Orange County and major communities.



Project Summary

The Orange County Transportation Authority (OCTA) provides transit service in a generally automobile-oriented part of southern California. Consequently, OCTA must plan its services and operations for maximum effectiveness and efficiency. To help with this challenge, OCTA has instituted a geographic information system (GIS) that provides to OCTA detailed information on the demographic and land use characteristics of all locations throughout its service area. OCTA uses this information to understand the characteristics of neighborhoods and commercial areas within walking distance of existing and potential bus routes and bus stops. With the insights developed with the analysis, OCTA is able to make efficient use of its resources and provide effective service to its customers.

Project Benefits

OCTA uses GIS to:

- Analyze and display travel patterns on the bus system in the context of surrounding land uses, demographics, and socioeconomic characteristics;
- Provide to staff, local officials, and the public understandable graphical information depicting service levels and system performance;
- Target the marketing of transit services to specific geographic and socioeconomic markets;
- Analyze the characteristics of current and potential riders at each bus stop in order to prioritize bus stops for ADA improvements;
- Control the administration of on-board surveys and analyze survey results to understand the travel patterns of its riders and to validate ridership forecasting models;
- Evaluate new bus stop locations for relative accessibility and estimate the ridership potential of each alternative location;
- Quickly evaluate the impact of potential service changes; and
- Transfer information efficiently between databases on transit operations, land use, population characteristics, and ridership patterns.

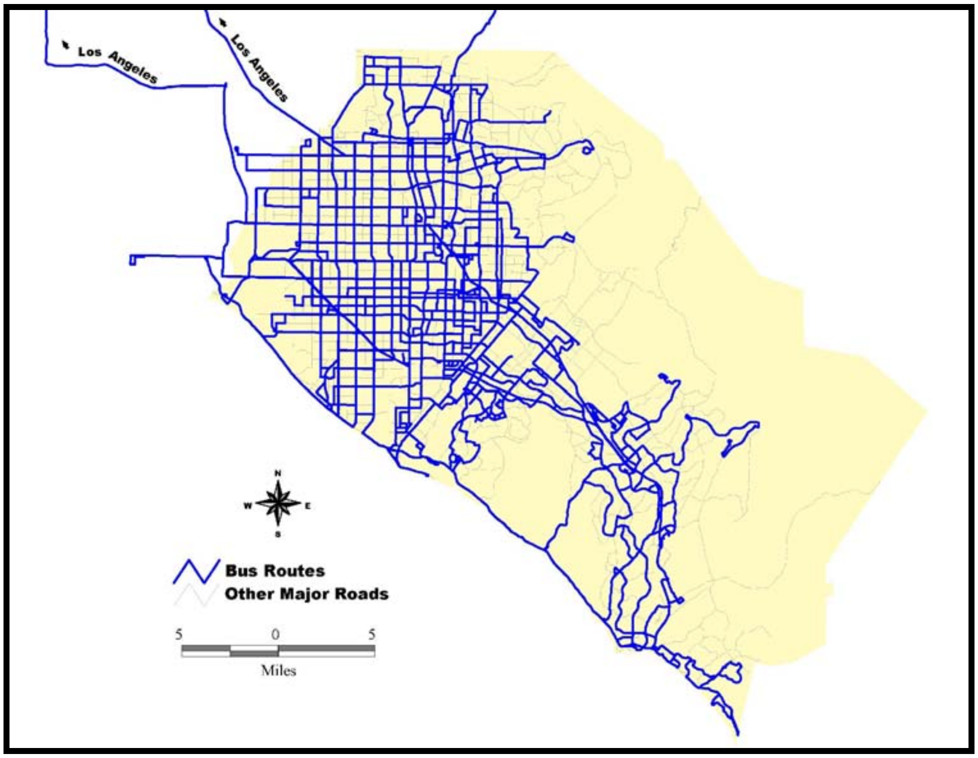
Background

The Orange County Transportation Authority (OCTA) is the consolidated transportation agency responsible for planning, funding, and operating county-wide transportation services in Orange County, California. Orange County has more than 2.5 million residents in 33 municipalities and surrounding unincorporated areas. The County has more than 1.24 million jobs, many of which attract workers from other counties.

Development patterns in Orange County present a challenge to the provision of effective transit services. Much of the county and its transportation system developed after World War II when travel has been dominated by the automobile. During that time, the urban areas within Orange County have grown and spread toward each other. The result is a relatively dispersed land use pattern that is served by an extensive network of freeways and arterial streets.

Within this setting, OCTA manages a regional transit system that is among the largest and fastest-growing in the nation. More than 60,000 individuals per day ride OCTA's 400 buses on 73 local, express and rail feeder routes. Ridership has increased nearly 13-fold since 1972, when county-wide bus service was launched with five leased vehicles serving approximately 1,300 daily riders. Figure 1 provides a map of the current fixed-route transit system.

Figure 1. OCTA's fixed-route transit system.



Even with the auto-oriented development patterns in the county, mass transit plays a vital role in the transportation system. Demographic data indicate a growing transit-reliant population in the county. The transit-reliant population includes:

- Senior citizens;
- Teenagers and children;
- Persons with disabilities; and
- Residents of low-income households that cannot afford an automobile.

In addition to the transit-reliant population, a growing number of people in the county are choosing transit for their commutes to and from work. OCTA's bus system serves all employment concentrations within the county and also provides connections to nearby commuter rail and light rail services. By attracting automobile drivers to transit, OCTA's bus system helps to reduce traffic congestion and improve air quality.

Because of the critical services provided by the transit system and the challenges presented by development patterns in the county, OCTA must manage its resources carefully in the provision of bus services. To accomplish this objective, OCTA must deal with complex questions on transportation behavior, demographics, and land use. This task requires data, spatial analysis techniques, and skilled personnel. OCTA uses a geographic information system – a GIS – as a primary tool in answering these questions.

GIS at OCTA

OCTA initiated its GIS program in 1991 with the acquisition of its first ArcInfo license, first running on a PC and then on a single UNIX Sun Sparc Workstation. Since then, OCTA has expanded the GIS role in transit applications from ad-hoc mapping support to analytical tasks that produce information for multiple users in different departments. Information requests emanate not only from the transit planning area within the Planning and Development Division, but also from the Operations Division, External Affairs, and other departments.

The GIS unit is staffed with a supervisor and two analysts who are trained in GIS programming, spatial analysis, mapping, spatial database design, and database management. The GIS unit also employs interns and consultants as needed. OCTA also has a digital graphics department that often works with the GIS staff on the preparation of reports, web pages, brochures, and posters that communicate information developed by the GIS unit.

OCTA continues to use ESRI products – ArcInfo and ArcView – as its primary GIS software. The GIS unit uses ArcInfo primarily for data management and editing, along with spatial analysis and hardcopy map production. The GIS unit requires powerful hardware to support the processing, storage and plotting requirements of GIS software. Staff performs computing tasks with Windows NT workstations connected to a Unix server. The GIS unit has a Hewlett Packard DesignJet color plotter for making large maps and several printers for smaller plots and transparencies. The staff uses digitizers to convert hardcopy maps into digital layers.

Various other OCTA staff members use ArcView for querying, viewing, mapping, and small-scale spatial analyses. These staff members run ArcView modules – customized user-friendly versions of Arc View that automate common tasks – that have been distributed throughout the Authority, taking advantage of ArcView implementation in the desktop computer environment. These modules give the users easily used capabilities for querying, viewing, and map plotting. The modules include tools for analyses of bus stops, design of transit routes, and market research analyses. OCTA uses other extensions and modules of ArcInfo and ArcView for specialized analyses, such as network modeling tasks with Network Analyst.

The most important, and usually most expensive, element of a GIS is data. Over the years, OCTA has developed and maintained spatial data of three principal types: land-use data, socioeconomic data, and transportation data. OCTA maintains this information in a master database that is expanded regularly with a data dictionary for various GIS project applications. Table 1 lists the key map layers maintained by OCTA. To support the maintenance of more complex data structures, some data, such as the bus stop inventory, are stored in a relational database management system (RDBMS). While most of the map layers have been prepared by OCTA, some of them are acquired from other sources, including public agencies and private vendors that specialize in spatial data products.

Table 1. Key map layers in the OCTA master database.

Map Layer	Description of Data
Existing and Proposed Transit Routes	Contains all bus routes of the current system. A separate database is maintained for a proposed system.
Bus Stops Inventory	Contains all bus stops for the current bus system. These bus stops assist in determining transit accessibility
Existing and Proposed Master Plan of Arterial Highways	Includes the arterial street network for Orange County. The attributes of this data include traffic data such as average daily traffic, capacity and, as a result, level of service.
Street Centerlines	Contains streets of all types in Orange County including freeways, arterials and local roads. Address ranges are provided in the attribute table of this layer so that the user can geocode locations by street address.
Transportation Projects	Includes transportation projects that are either programmed or planned.
Transportation Analysis Zones (TAZ)	The TAZ layer contains geographic zones, which share similar socioeconomic characteristics. The TAZ data is used as input for a transportation forecasting model.
Aerial Photos	These photos are digital images that can be shown along with other layers. They can be used for verifying land use and defining transportation analysis zones (TAZs).
Travel Surveys	Contains various market research surveys with origin-destination and trip generation data. For example, on-board transit surveys, senior travel survey and college student travel survey.
1990 Census Information	Contains census data at the tract, block group and block level.
Land Use	Contains an inventory of land use throughout the county. The resolution of the land use layer is two- to three-acre parcels. Each parcel is coded with one of many land use categories. This layer was developed with the aid of high-resolution aerial photographs.
Political Boundaries	Contains district boundaries for local governments.
Bikeways	Contains all facilities used for bicycle transportation. This layer is useful since buses are now equipped with bike racks.
Park-and-Ride Facilities	Includes park-and-ride lots. These lots are heavily used by transit patrons.
Geocoded Employer Database	Contains all employment locations. Employers are categorized by industry codes.
Major Transit Destinations	Includes all primary locations used by transit patrons. This layer is useful for locating transit routes for the fast growing segments of the transit-reliant population.

GIS Applications at OCTA

Since its inception at OCTA, the GIS unit has evolved into a valuable technical resource that performs many interdepartmental tasks. Some of the uses of GIS at OCTA include:

- The administration and inventory of bus stops throughout the OCTA transit system. The inventory is maintained through a GIS database.
- The analysis and visualization of the accessibility of bus stops by associating bus stops with socioeconomic data in a GIS environment.
- The evaluation of transit service changes by using GIS to analyze alternative alignments of transit routes. The analysis determines how service changes affect ridership.
- Displaying passenger count data on maps by linking count data to a transit route database in a GIS and producing maps. These maps show spatial variations of transit volumes along a specified route.
- The administration and analysis of on-board surveys by linking survey data with transit route data. Transit planners can map the spatial distribution of on-board surveys to assure proper sampling. The results of on-board surveys can be linked with transit data in a GIS environment to display origin-destination pair locations, boardings, alightings, and major transfer points.
- The analysis of the productivity of transit lines by using GIS to link passenger count data to transit route data.
- Displaying and validating travel demand model inputs and results by linking model data with GIS layers. Modelers can enter, display and store input parameters for travel demand models in a GIS environment. They can also link model output data to transportation network layers in a GIS to display results such as projected traffic volumes.
- The analysis of travel characteristics of paratransit patrons for use in determining their potential for fixed-route bus service. OCTA can determine which paratransit users are potential candidates for fixed-route transit service by measuring the transit accessibility of origin-destination locations of paratransit users.

In addition to transit planning, OCTA uses GIS to:

- Enhance public outreach by producing high-quality maps that display transit facilities and demographic information.
- Support the marketing of transit services by analyzing service improvements and presenting the results to stakeholders.
- Administer railroad right-of-way programs by storing and managing the agency's real estate in a GIS database.
- Manage highway performance data by storing and maintaining traffic volumes, capacity and level of service.
- Provide interfaces with transit operations systems so that operators can add a geographic element to their scheduling and automatic vehicle locator (AVL) systems.

Role of GIS in Transit Planning

This section focuses on three of the many tasks for which OCTA employs GIS tools. The first is the disaggregation of socioeconomic data to a level that is sufficiently detailed to support analyses of accessibility to transit. The second is the mapping of data from transit surveys. The third is the analysis of pedestrian accessibility to bus stops.

Disaggregation of Socioeconomic Data

Socioeconomic data is vital for determining locations for transit routes and facilities. Often, socioeconomic spatial data resides in a zonal layer – census tracts or transportation analysis zones (TAZs), for example – where each zone contains such attributes as population, housing units, and employment. A single zone in such a layer may cover a very large area. While socioeconomic data aggregated to these large zones are useful for regional analyses, they can support only a relatively crude analysis of accessibility to individual bus routes and bus stops. OCTA recognized this problem in analyses using current socioeconomic data at the census tract level. To solve the problem, OCTA used GIS tools with land-use information to disaggregate the census data.

To accomplish the disaggregation, OCTA overlaid the census tract layer shown in Figure 2 onto the layer shown in Figure 3 representing small-area land use. The land use layer has a higher resolution of detail since each feature in the layer is a two- to three-acre area that is encoded with a specific land use class.

The approach to disaggregation is easily illustrated with a larger-than-normal tract with a moderate-sized population that is concentrated in few contiguous blocks. Computed at the tract level, the average population density understates the population density – and potential transit market – that exists within a portion of the tract. GIS tools can produce a better representation of the population distribution by tapping information from the land-use layer on actual locations of housing within the tract. The resulting estimate of population locations reveals that most of residents of the tract are located in high-density housing in a compact subarea of the tract. Figure 4 illustrates the resulting layer that more accurately represents population distribution and density within tracts. The same approach can be applied to zone-level employment data as well by using GIS to link it spatially with data on the location and extent of office, commercial, and industrial land uses in each zone. The more precise distributions of population and employment are much more useful to transit planners in efforts to locate bus routes and bus stops to serve areas of high population and employment. Thus, employing the automated spatial analysis utilities of a GIS, OCTA uses multiple map layers to produce a less aggregated and more spatially accurate layer.

GIS can also be used to perform the reverse of this process by aggregating data associated with smaller areas into a larger zone. In general, one of the most useful capablities of GIS is the manipulation of data that is rich in attributes across different levels of aggregation for use in various analysis.

Figure 2. Population density, by tract, in central Orange County.

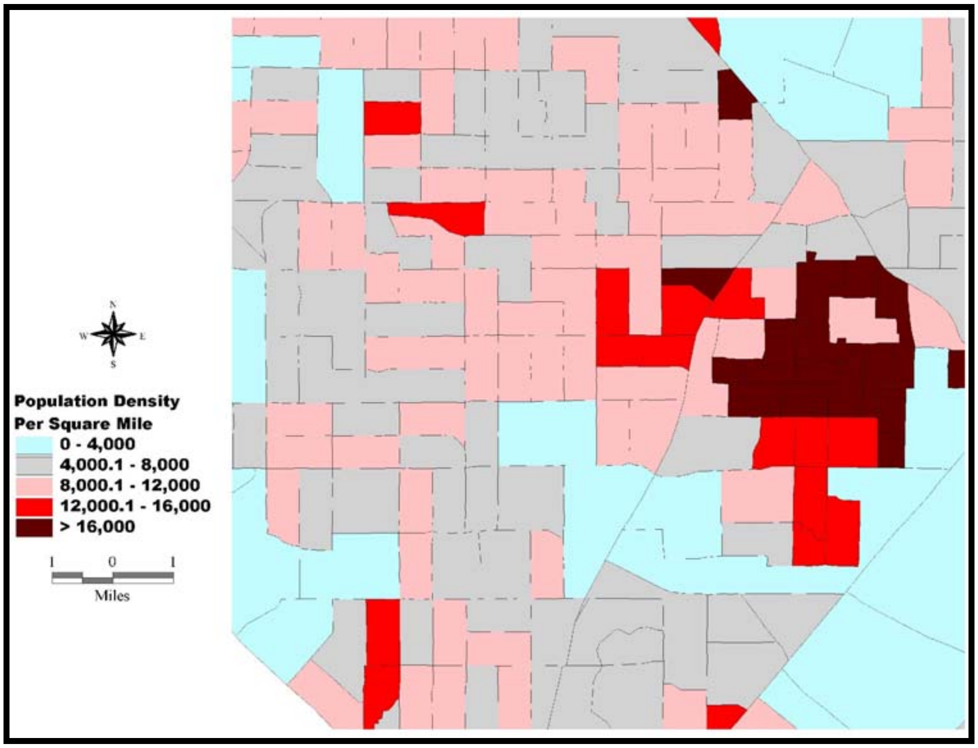


Figure 3. Land-use in central Orange County.

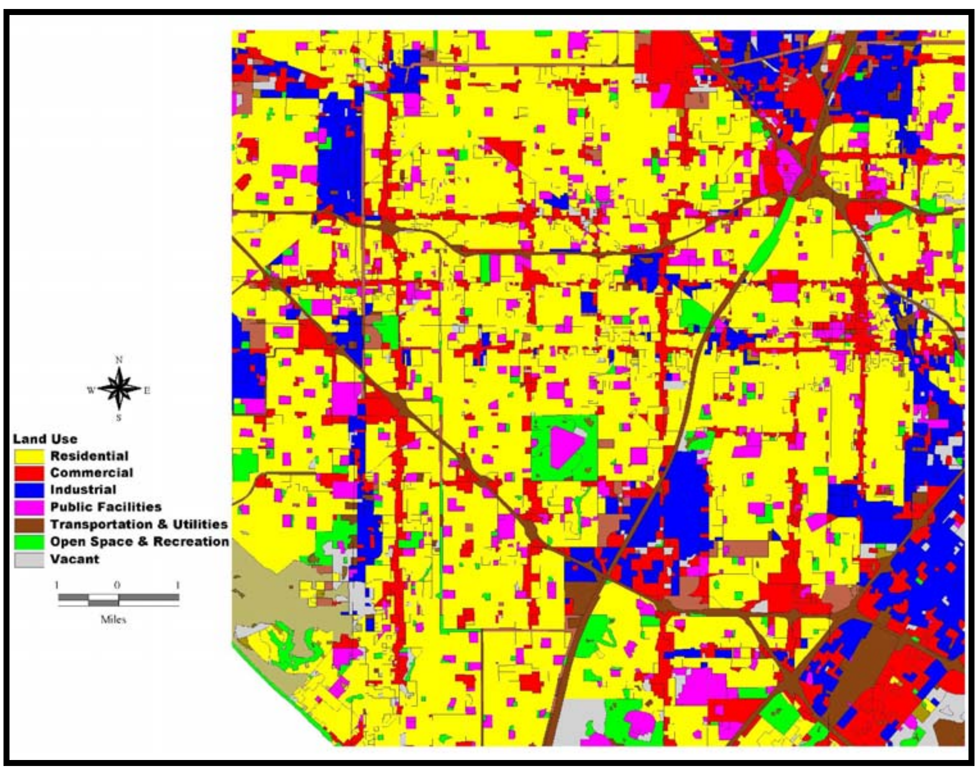
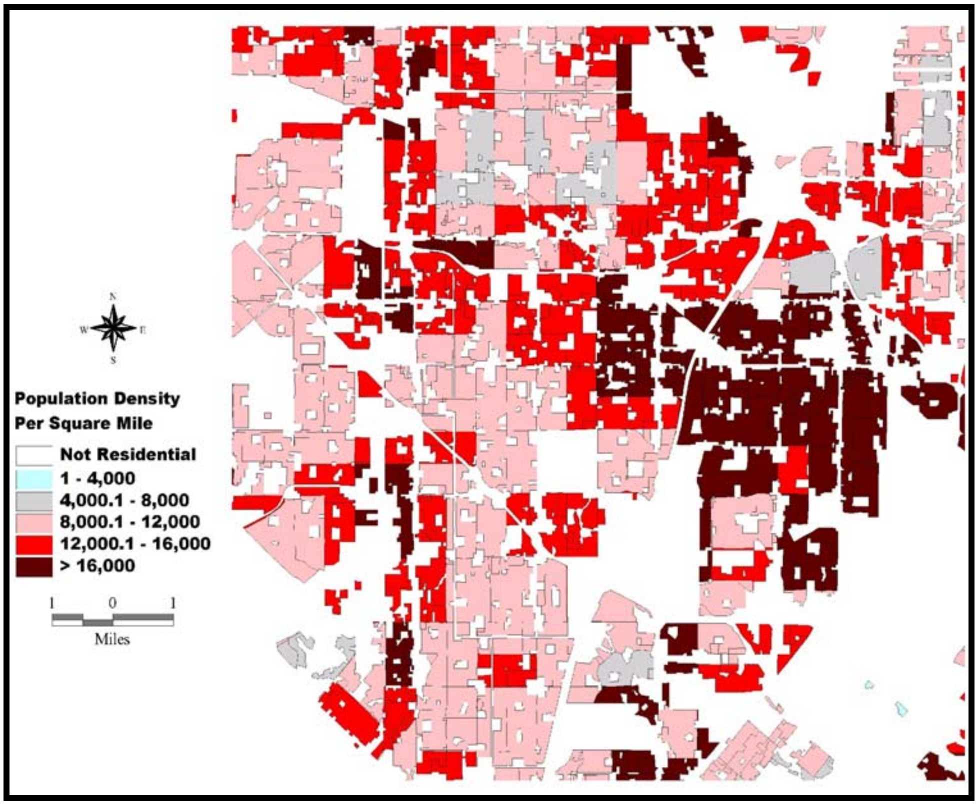


Figure 4. Disaggregated population density.



Analysis and Visualization of Transit Survey Data

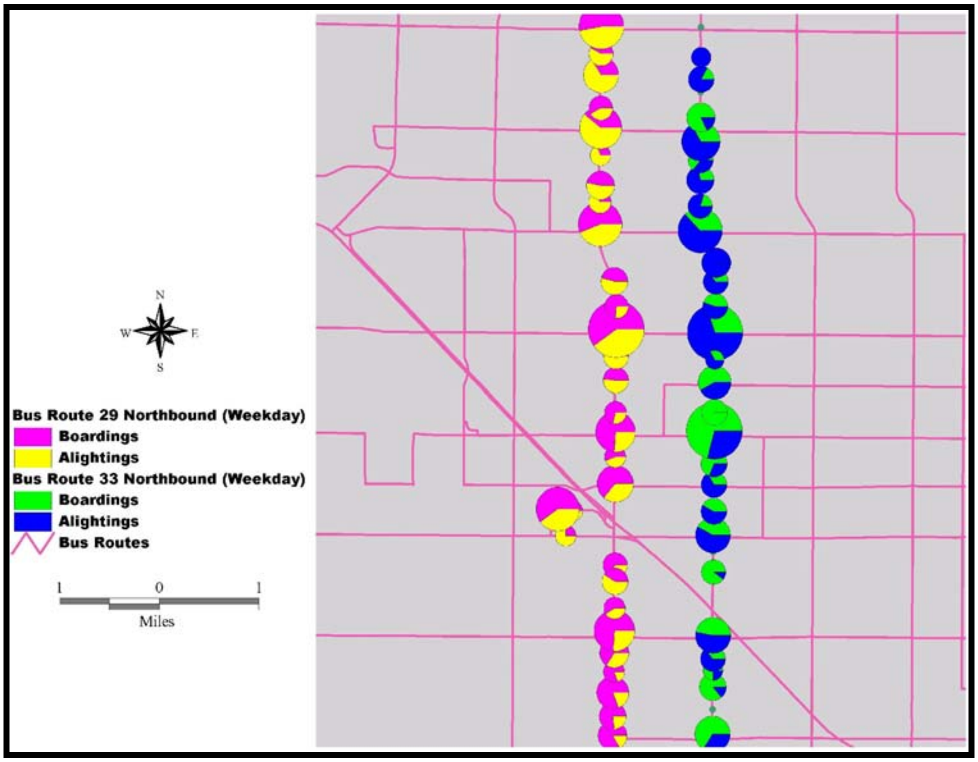
Because the demographic and travel patterns of Orange County are constantly changing, OCTA must continually monitor the bus system to evaluate its performance and effectiveness. The Authority frequently obtains ridership counts and performs surveys of the characteristics of transit riders. OCTA uses GIS to help collect, compile, analyze, and maintain ridership data. GIS also plays a central role in helping planners and other staff members use the data to understand current conditions and make decisions regarding potential service changes.

In the presentation of ridership data, OCTA relies heavily on the ability of GIS to produce maps that convey the locations of various attributes of bus routes and bus stops, including: the numbers of riders boarding and alighting at each stop; the volumes of riders on individual links of individual routes; and the number of riders transferring between routes at individual stops. Combining the ridership data with information derived from other sources, OCTA is able to derive a number of performance statistics. For example, with the headway and vehicle-capacity on each route, OCTA is able to derive and map the load factor (volume divided by capacity) for each link of each bus route.

Currently, OCTA uses manual techniques to count riders boarding and alighting at every bus stop on a route-by-route basis. Data collection may include just a sample for a peak-period run or may cover all runs for an entire day. In the near future, OCTA will implement automated methods that will provide count data continuously. OCTA enters the counts from individual bus stops into the GIS database linked to the bus stops layer. The GIS is then able to display the spatial distribution of boardings and alightings.

Figure 5 is an example that shows all boardings and alightings for a weekday for the bus stops on two northbound routes. Figure 5 is useful in the visualization of the on-off patterns on each of the routes. The figure displays data for two routes that serve different sets of bus stops. The display of data for routes that serve a common set of stops usually requires the preparation of separate maps to avoid cluttered overlapping symbols at the common stops.

Figure 5. Daily boarding and alighting volumes for two transit routes.



Alternatively, the display of total volumes at bus stops is both useful and straightforward. The data are readily summed for all routes stopping at each stop. The resulting map, which shows total boardings and total alightings at each stop, is useful in understanding the ridership market at each stop. Such a map might help a planner to set priorities for the location of new shelters at stops where large numbers of riders board the bus system.

Data on boardings and alightings at each stop also permit the calculation and display of rider volumes on each link of each bus line. Links are defined as the individual segments of a bus route between the stops that the route serves. Rider volumes are readily computed from the boardings and alightings on successive stops of each bus route. These link volumes can be associated with the individual route segments in the GIS layer that describes the bus routes. Figure 6 is an example display of data derived with this approach for a single bus route. This display is useful in visualizing loadings on vehicles, comparing the volumes to loading standards, and making decisions on adjustments to headways and other service characteristics.

A useful variation on this analysis is the calculation and display of the total number of riders on each link, computed across all bus routes that operate on that link. The mapping of this information supports the visualization of overall volumes and the identification of high-volume corridors in the bus system.

Boardings, alightings, and computed link volumes can be compared with analogous information derived from on-board surveys or ridership forecasting models. Such comparisons are useful in the sample-expansion for on-board surveys and the validation of forecasting tools.

Yet another useful analysis of ridership information employs data on rider transfers that occur in the bus system. A transfer occurs when a rider alights from one bus and boards a second bus in a single trip – from home to work, for example. Data on transfers are available through farebox registrations, ridechecks, and on-board surveys. Figure 7 is an example of the use of GIS to compute and display the number of transfers that occur at various locations throughout the bus system. The display of this information can identify locations that might be priorities for improving passenger facilities, posting of transit schedule information, and adjustments to bus service patterns.

Figure 6. Average weekday transit link volumes for a single route.

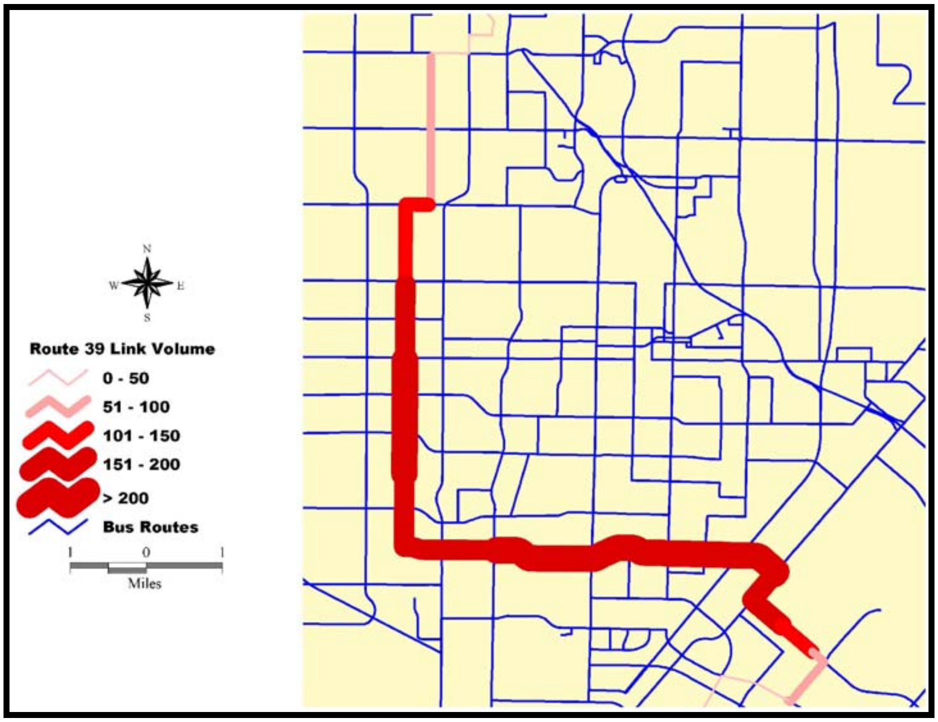
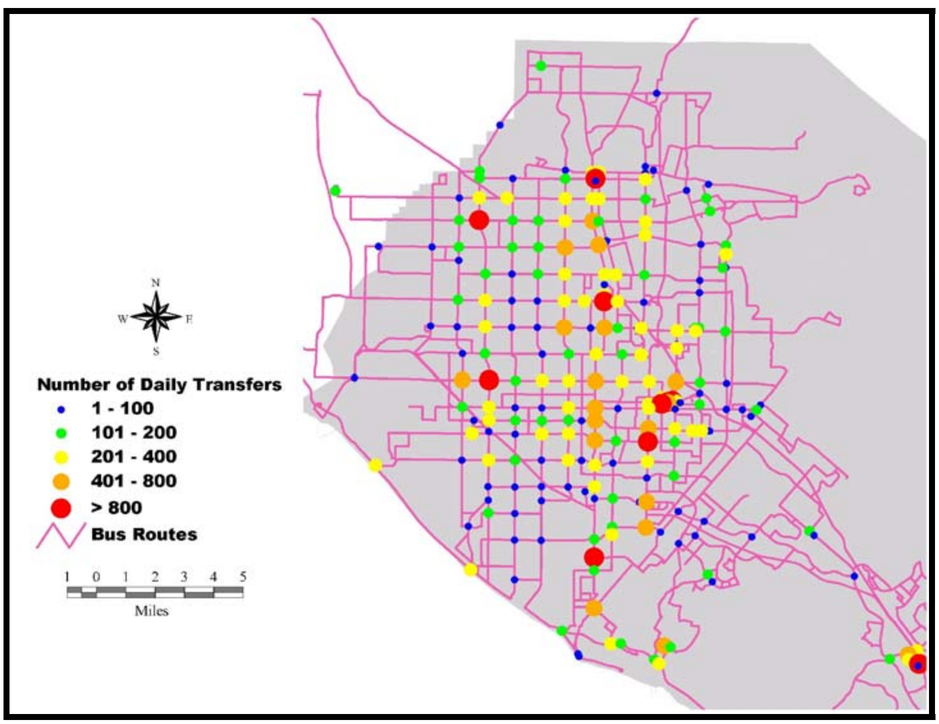


Figure 7. Daily systemwide transfer volumes.



Determining Walking Accessibility to Bus Stops

Pedestrian accessibility is an important factor in the determination of the alignment of a transit route and the locations of bus stops. On-board surveys in Orange County have consistently shown that 80 to 90 percent of bus riders walk to and from their bus stops.

The calculation of accessibility requires the identification of the "catchment area" around each bus stop – that is, the area from which potential riders would be willing to walk to and from the stop. GIS tools can be used to identify catchment areas in several ways. The selection of a particular approach is determined largely by the availability and accuracy of the necessary spatial data. This section presents three ways of determining catchment areas around bus stops.

Route-Buffer Catchment Areas

The simplest approach to building transit catchment areas is to create a buffer around an entire route, as depicted in Figure 8. The buffer is centered on the route of interest and is defined by the maximum distance that riders find convenient to walk to and from the system – typically one-quarter mile or so. This method is commonly used to describe fixed-route service areas for federal reporting purposes. The approach implicitly assumes that all locations within the buffer are accessible to the route. However, this assumption may overestimate accessibility because the route is only accessible at bus stops. Nevertheless, this approach can be useful when bus stop locations are not available in the GIS. The approach is commonly used, for example, to examine the general accessibility of alternative future transit routes for which bus stop locations are not yet known.

Stop-Buffer Catchment Areas

The second approach to building catchment areas is to create a buffer around each individual stop served by a route. This approach improves the accuracy of resulting measures of accessibility to the route but requires the availability of a bus stop layer that has coordinate locations for each stop. Figure 9 illustrates the results of this approach for the same route used in Figure 8 to illustrate the use of a route-level buffer.

While the stop-level approach clearly improves the accuracy of the analysis, it implicitly assumes that all locations within each buffer are within the defined walking distance of the bus stop. The geometry and connectivity of the street system, however, may result in actual walking distances that are much further that the distance implied by the buffer. Dead-end streets, cul de sacs, freeways, and interchanges – all characteristics of auto-dominated development patterns – can cause circuitous walk paths that are not recognized by the buffer approach.

Figure 8. A catchment area created from a one-quarter mile buffer surrounding a transit route.

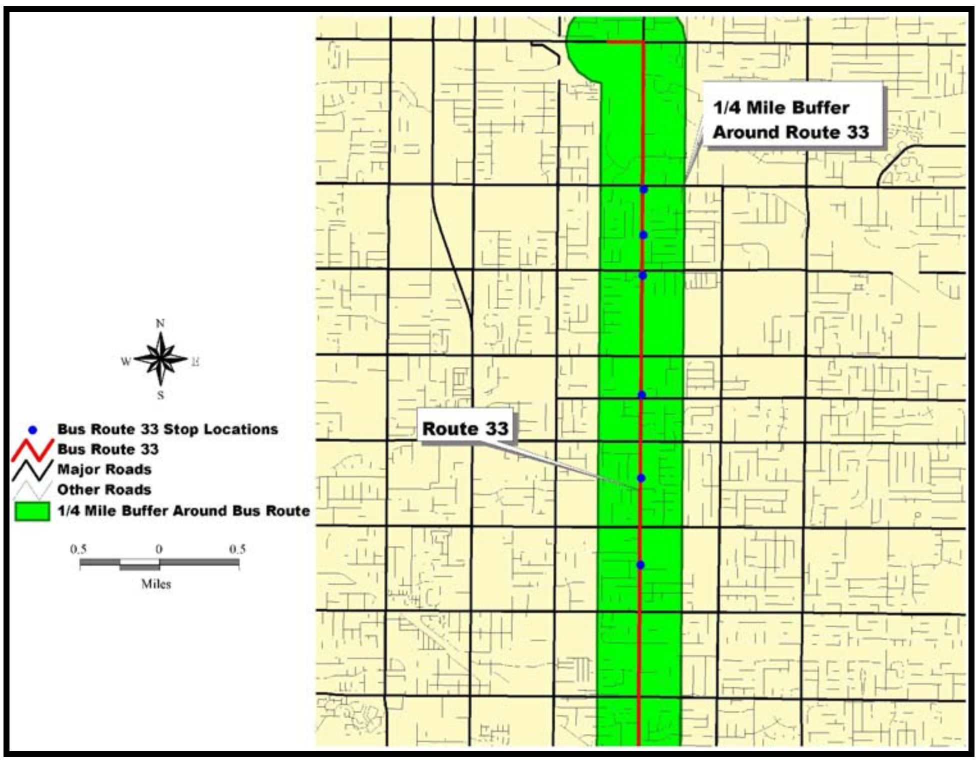
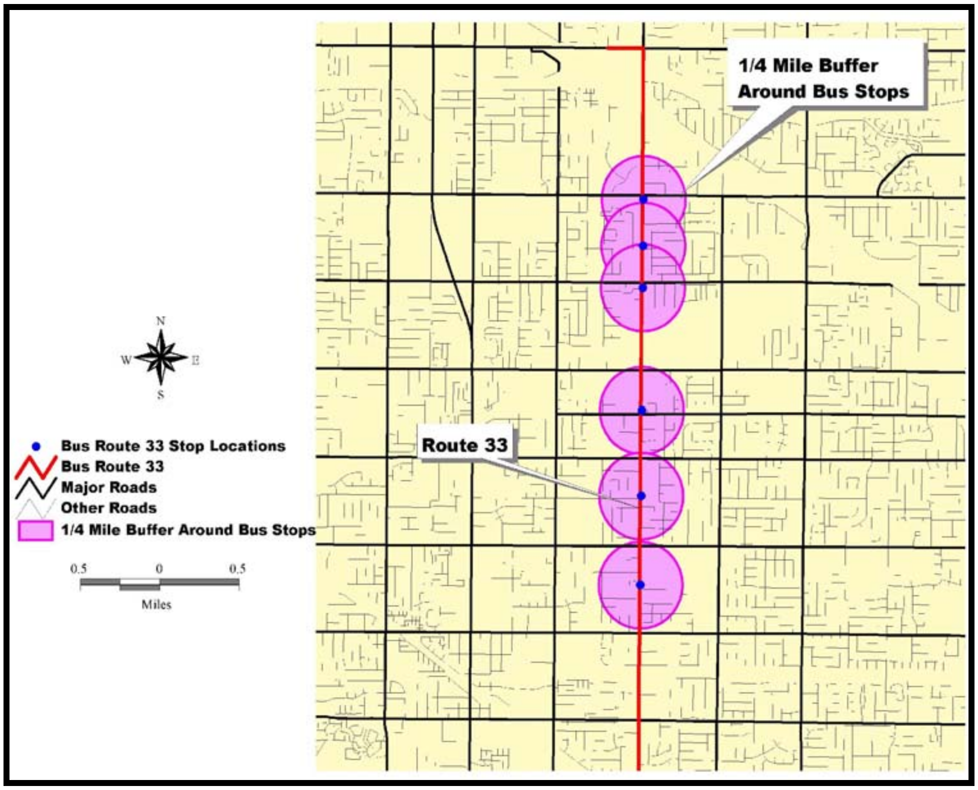


Figure 9. Catchment areas created from one-quarter mile buffers around bus stops.



Network-Based Catchment Areas

The third approach to building catchment areas is to identify all links in the street network that can be reached from a bus stop by walking along the network for less than the specified maximum walking distance. This approach requires network analysis tools and a spatially accurate street network that identifies facilities that can be used by pedestrians – streets, roads, and pedestrian-ways in contrast to freeways and expressways.

Several methods can be used to exclude facilities not available to pedestrians. These facilities can be removed entirely from the layer that describes the streets-and-highways system. Alternatively, the not-walkable facilities can be excluded from the selected set before any network operation is performed. Finally, these facilities may be assigned artificially long distances that would prevent their inclusion in any shortest path to and from a bus stop.

The addition of pedestrian-only facilities may be important to an accurate portrayal of possible walk paths to and from bus stops. Pathways in residential areas and pedestrian connections in commercial areas can play important roles in providing access to bus stops. Depending on the location and importance of these facilities, their addition to the street network may be important to the accuracy of the results.

Most GIS software has network analysis capabilities that can be used to create network-based catchment areas. The user specifies the origin points (stop locations) and maximum walk distance. The network tools then determine the walk network around each origin point (bus stop) that lies within the user-specified distance. Figure 10a illustrates the results of this analysis for the same route shown in Figures 9 and 10. Figure 10b focuses on three of the stops on that route, contrasting the results from the buffer-based approach and the network-based approach. Because the network-based approach is able to recognize disconnects in the street network, it is able to identify the walk-accessible service area for each bus stop with much better accuracy.

Figure 10a. One-quarter mile walk networks are created around bus stops.

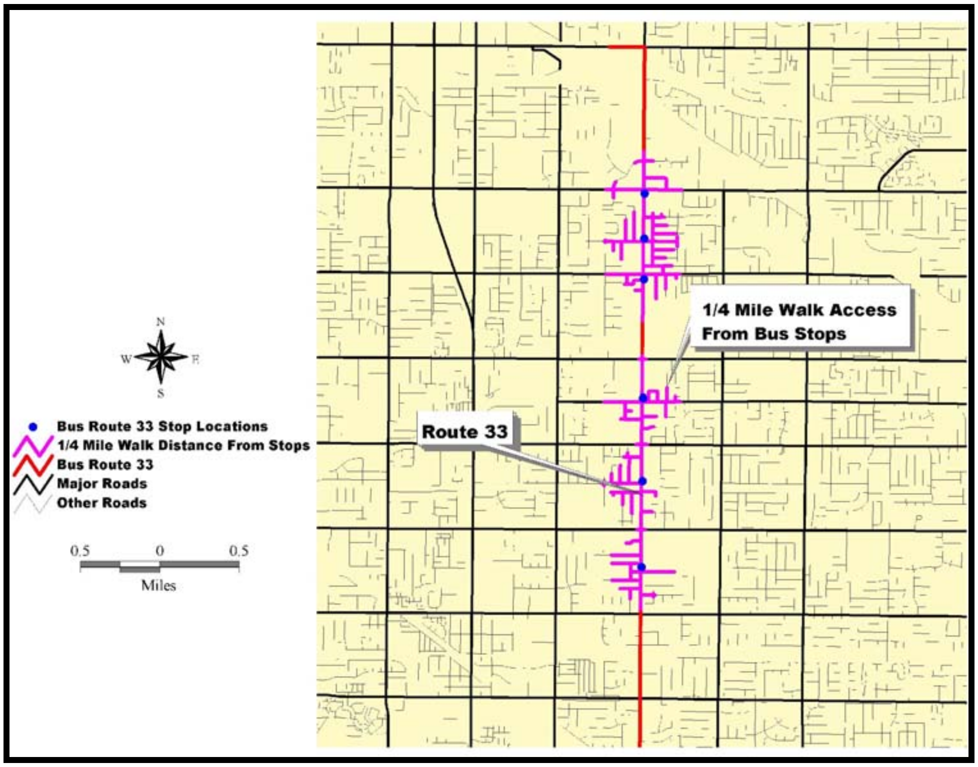
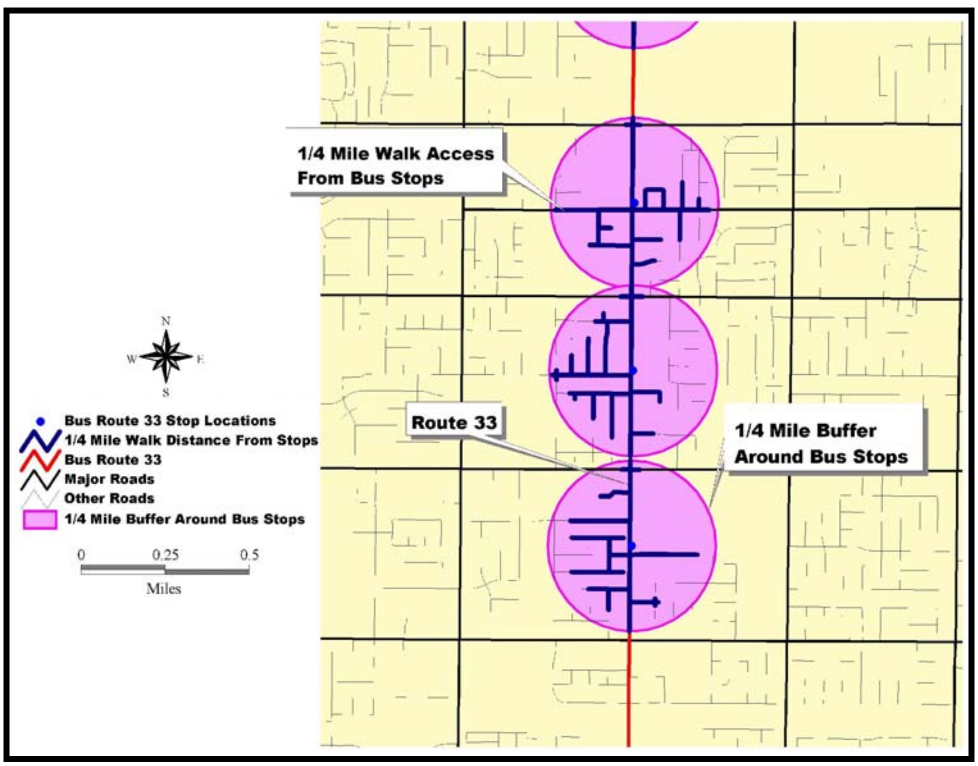


Figure 10b. Comparison of one-quarter mile buffer and one-quarter mile walk network at bus stops.



Calculation of Accessibility Measures

Once catchment areas have been identified, they can be used to estimate the number of persons or jobs that are walk-accessible to the bus system or to an individual bus route. Selection of a method to prepare this estimate depends on the method used to identify the catchment area.

If one of the buffer-based approaches has been used, then GIS can be used to overlay the buffers onto a layer that contains demographic data (with traffic analysis zones, Census tracts, or Census block groups, for example). The GIS can then estimate persons and jobs within walking distance of a bus stop based on the fraction of each demographic area that falls within a buffer.

If a network-based approach has been used to identify walk-accessible locations, then the analysis can use the network to estimate the fraction of each demographic area (zone, tract, or block group) within walking distance. The GIS overlays the demographic layer onto the network and sums for each demographic area: 1) the total length of its walkable network facilities; and 2) the total length of its walkable network facilities that are within the maximum walking distance of a bus stop. The fraction computed by dividing 2 by 1 then provides the basis for estimating the fraction of persons and jobs that are within the maximum walking distance of at least one bus stop. Estimates for individual bus stops can be prepared by repeating this analysis for each stop and using the network-based catchment area determined for each stop. These analyses can provide a wealth of information for the population and employment served by each stop, depending on the information available in the demographic layer. Accessibility measures computed for individual stops can then be used to develop route-level and system-level accessibility measures.

GIS Requirements and Benefits

As a transit agency, OCTA has special requirements in addition to the basic requirements for supporting GIS. This section describes both basic requirements and transit-related requirements for a GIS, focusing on hardware, software, staff and data.

Hardware & Software

To support GIS, an agency needs to consider the initial and continuing investments in software, hardware, staff, and data. The software and hardware requirements depend on the amount of data that need to be stored, the types of spatial analyses that need to be performed and the number and types of users. An organization that needs to manage large amounts of data that cut across many departments should consider a GIS software product that is capable of organizing, storing, editing, processing and integrating spatial data. This type of software requires a high-end workstation or server for better speed and performance. However, not all GIS tasks require a workstation-level GIS. Smaller desktop GIS packages are available for analysts and intermediate GIS users to view, query, and perform simple spatial operations on data. For maximum productivity, each member of the GIS staff should have a personal computer configured to run desktop GIS applications. OCTA employs a workstation GIS for data development, maintenance, and large-scale spatial analysis. OCTA uses desktop GIS for querying data sets, mapping project results and performing some analyses.

GIS Staff

The typical staff of a GIS unit includes a coordinator who manages one or more analysts at the junior and senior level. The coordinator decides how to allocate GIS resources, including how to spend GIS funding. The coordinator should have a strong technical background with several years of experience with GIS software. In addition, a coordinator must have project and resource management skills.

Analysts at the senior level must be highly skilled GIS users with experience in programming and database management. Senior analysts design and develop GIS applications; manage the GIS database; manage the GIS software; and define tasks for junior analysts. Junior analysts are typically entry-level or mid-level GIS users. They do the majority of spatial analysis work as well as enter and edit data, produce maps, perform statistical analyses and do GIS programming. Like most high-technology staff, GIS technical staff must easily adapt to new developments in technology. Continuous training is critical for keeping the staff skilled in these developments and in new releases of GIS software. If the agency does not maintain sufficient in-house staff with necessary levels of GIS expertise, contract consulting staff can help meet ongoing or temporary needs. OCTA uses this business model by employing a coordinator to oversee the efforts of two dedicated GIS transportation analysts, interns, and consultants.

GIS Data

Accurate and timely data is critical to the success of a GIS department. Data can be developed in-house, purchased from commercial vendors or obtained from other public agencies. Database design requires skilled personnel and it is often helpful if an agency has an information systems department to assist in database design and management tasks.

Specific Requirements for Transit GIS

Transit GIS requires specific data sets in addition to those used for general GIS. The following list shows both the basic data and transit-related data required for a GIS.

Street-centerline file: This layer should include street names, address ranges, jurisdictional data, and other attribute data. The street centerline file serves as a map reference layer, a database to geocode bus stops and trip origins-destinations, a base layer for building transit routes, and provides a source for networks used to determine shortest paths, walk networks, and accessibility measures. The street network is also used for non-GIS purposes, including transit scheduling and trip itinerary planning.

Bus stop inventory: This is a layer of points or coordinate positions representing the location of bus stops. This layer generally contains attribute data, such as unique stop identifiers, stop names or descriptions, and can contain such other data as the presence of bus shelters, ADA compliance and maintenance schedules. Departments throughout transit agencies use bus stop location data for planning, scheduling, customer information, operations, maintenance and other purposes. Passenger count data, associated with stop locations, also can be viewed and analyzed within GIS.

Bus route inventory: A route layer built on top of the street network may be used for many different purposes, especially if it is enriched with such attribute data as headways, capacity or travel speeds. Passenger count data can be summarized using a bus route layer to display and analyze travel patterns, monitor system performance, develop load profiles, validate demand model results and other purposes.

Other GIS data essential for transit planning include census land-use and employment data. Some data, including those for street networks, and employment, may be purchased from vendors. Most census data and other socioeconomic information are free from the Bureau of Census or Bureau of Transportation Statistics.

Specific GIS software modules and extensions that perform network analysis are useful for transit planning. A network analysis module and/or extension can assist in finding efficient transit routes between origins and destinations; building walk paths around bus stops to measure transit accessibility; and determining the closest transit facilities to major employment and shopping centers.

Benefits of Transit GIS

OCTA has realized three kinds of benefits from the use of GIS in transit planning: better communication of technical information, more efficient development and maintenance of data sources, and more comprehensive analyses of transit planning questions. To help improve communications between planners and decision-makers on technical matters, OCTA has used GIS to transform information from tabular formats into visual displays. This application is particularly effective because so much of the information – about transit routes, bus stops, and demographic distributions – is naturally tied to specific locations.

To enhance the efficiency of data-related tasks, OCTA has used GIS as a way to organize and connect geographically the data sources maintained by different departments in the agency. Because this connection means that each data source is immediately available to all departments – not just the department that develops and maintains it – each department no longer has to duplicate the efforts of others to maintain and update copies of potentially useful data sources.

Finally, to improve analytical capabilities, OCTA has used GIS and its data-integration tools to expand the breadth and depth of work to answer real-world planning questions. These analyses have previously been either not possible or very cumbersome without the ready capability of GIS to tie together different information based on geographic relationships. As a result, OCTA is now able to uncover and communicate insights from the data that previously have been difficult to detect without GIS.

A recent example of GIS application by OCTA highlights the benefits of these new capabilities. OCTA undertook a review of the ridership patterns on its paratransit services with an eye towards identifying riders who might consider switching to OCTA's conventional fixed-route services. In this analysis, OCTA used the GIS to process operational records of individual trips on the Authority's paratransit service, locate the origin and destination of each trip geographically, and identify any special needs of the rider. OCTA then used the GIS to determine whether the rider could have used the Authority's fixed-route system to make the same trip. This analysis showed that a significant number of paratransit trips might be made as effectively via the fixed-route system. OCTA then worked with various social-service agencies in the community to present the results of the analysis as it applied to that agency and its clients. GIS mapping tools were central to these discussions because they permitted OCTA to tailor each discussion to the specific location of each agency and the specific travel needs of each agency's clients. In summary, in one analysis of ways to increase the effectiveness of the Authority's paratransit and fixed route systems, OCTA used the GIS to support better communication of technical information, tap data from a range of sources, and process these data in ways that would have been very difficult without GIS tools.

Conclusion and Lessons Learned

OCTA has successfully applied GIS to its transit planning efforts for nearly 10 years. The result is a reduction in the time, effort and funds needed to perform analyses used in the decision-making process. During OCTA's implementation of GIS, the GIS staff has learned these key lessons:

1. **Start simple and evolve:** Focus on simple tasks first and structure project-specific data files in an organized manner. Then, the GIS-transit database will continue to expand and be used for other projects by other departments.

2. **Pursue teamwork:** New GIS users need time and project application experience to understand GIS technology and how it can benefit transit operations and strategic planning.

3. **Establish data standards among users:** Data standardization is a critical element in GIS implementation. Work with users to standardize their data format for ease of import into the GIS system.

4. **Work with other transit operation programs:** A GIS can support various departments within the organization by establishing a standard system interface in a client/server environment. With this interface, the GIS can be used not only for organizing data but also for disseminating data, project results and maps.

OCTA will continue to use GIS for its transit planning efforts in the future. The agency intends to make spatial data available to in-house, non-GIS users via an Intranet. The data will include demographic data, route alignments, and analysis results. Therefore, instead of viewing hardcopy maps, planners will be able to interactively create customized maps, using GIS data, within a web browser. This is one of the future applications that OCTA's GIS Unit will work toward as it continues to provide a high-quality service to transit planning and other business functions throughout the agency.

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